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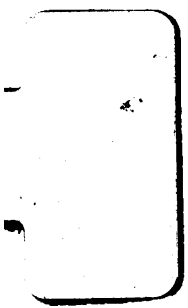

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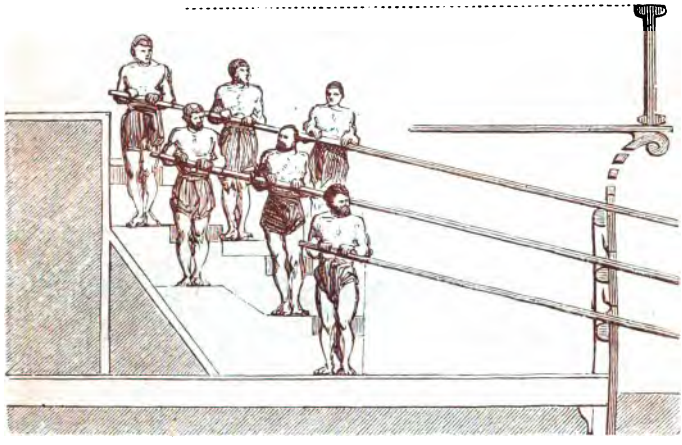
ON ANCIENT GALLEYS,

AND

THEIR MODE OF PROPULSION.

BY

W. S. LINDSAY, ESQ.



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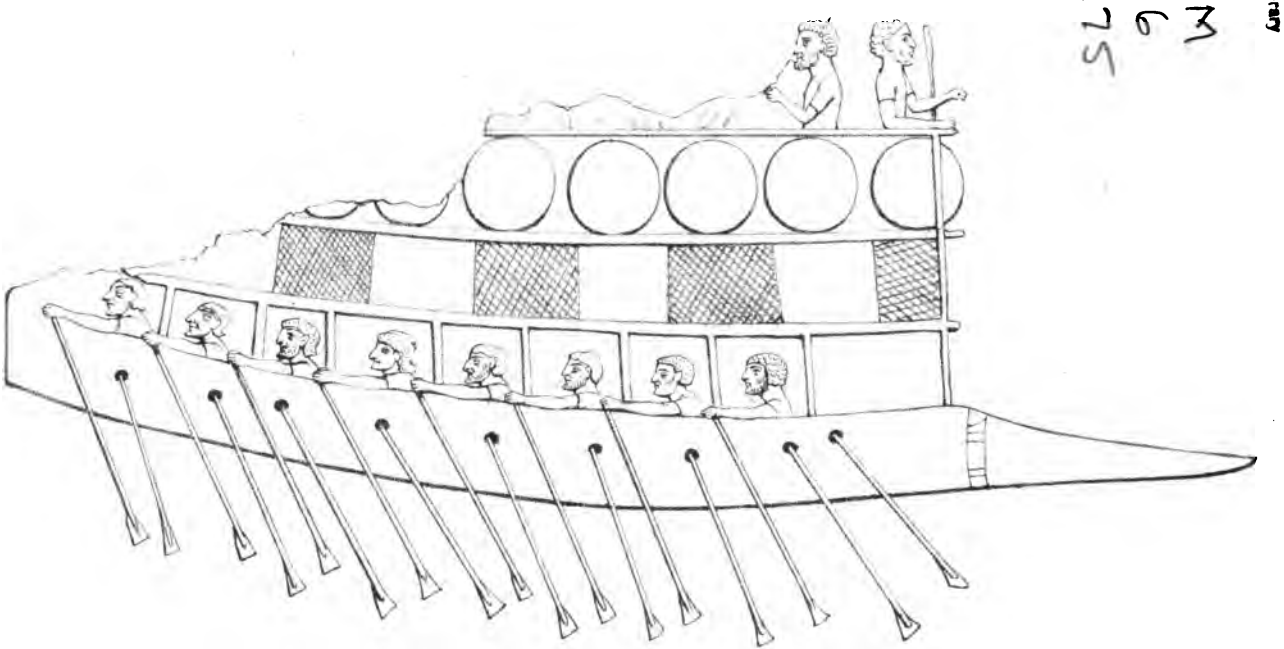

ANCIENT ARMED GALLEY IN MOTION. See p. 22

[Copied from a Slab which formed part of the old Palace of Koyunjik, now exhibited in the Koyunjik Gallery, British Museum]

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ON ANCIENT GALLEYS, AND THEIR MODE OF PROPULSION.

[THE following paper will form a part of a large and important work on the shipping of all nations, for which my friend Mr. Lindsay has been during some years collecting materials: I am induced to read it to you this evening because, while examining some of Mr. Lindsay's papers his views on the manner in which the oars were arranged in ancient galleys—in other words, on the way in which the motive power was utilized in the case of Triremes, etc.—appeared novel, and tending materially to solve a problem from all time a puzzle to the learned. Mr. Lindsay has kindly acceded to my request, that he would allow me to make such use of his papers on this subject as I thought best: I shall now, therefore, read to you such portions as I think will most clearly convey his meaning to the Society.

I ought perhaps to add, as many of you may not be aware of this fact, that the writer, Mr. Lindsay, was once well known in the commercial world of England as an extensive shipowner, and that he sat in Parliament for the Tynemouth boroughs, and afterwards for Sunderland, for fourteen years. He has now for some years been confined to his arm-chair by the severe affliction of paralysis in his lower limbs, and the work of which I am now going to give you some extracts has been the study and the amusement of a mind which retains its intellectual powers unimpaired.—W. S. W. V.]

ON ANCIENT GALLEYS, AND THEIR MODE OF PROPULSION.

BY W. S. LINDSAY, ESQ.

[Read before the Royal Society of Literature, Feb. 15, 1871; Sir PATRICK COLQUHOUN, V.P., in the Chair.]

Ancient Galleys.

Frequent reference has been made in the course of this work to the row-galleys of the ancients, and no subject connected with shipping has called forth more conflicting opinions: nor is this surprising. Most ancient writers who refer to it are less or more at variance with each other; while the engravings on coins and monumental sculptures are generally so confused and contradictory that they afford little assistance in its elucidation. Within the last two centuries numerous authors have endeavoured to solve the problem how these galleys were classed and rowed, and to establish a system of propulsion which, while applicable to every class, would harmonize with the accounts preserved of the size of these vessels and of the number of rowers employed on board of them.

Different descriptions.

Galleys appear to have been rated by their banks of oars, that is, uniremes had one, biremes two, triremes three, quadriremes four, quinqueremes five, hexiremes six, septiremes seven, octoremes eight, and so forth, up to the enormous ship, with forty banks of rowers, built by Ptolemy Philopater. But the chief point of controversy has been what constituted a bank or *tier*.

According to Homer, the Greek fleet at the siege of Troy consisted entirely of uniremes. They were

then undecked, with the exception of a platform at each end on which the archers or principal fighting men stood; and were guided by oars or sweeps at both extremities, so as to ensure rapid evolution. Pliny states that the Erythræans were the first who built biremes. Various ancient writers give the Corinthians the credit for having been the first to construct triremes. "And now Greece," remarks Thucydides,[1] "began to construct navies and to apply herself more assiduously to nautical affairs. The first who introduced a change in the structure of vessels, so as to form them very nearly in the present mode, are said to have been the Corinthians; and *triremes* are thought to have been built first for Greece at Corinth. It appears, too, that Amiocles, a Corinthian ship-builder, also constructed four such vessels for the Samians."

B.C. 1184. about. B.C. 900 B.C. 786.

Although triremes, in the time of Thucydides, and for some centuries afterwards, were more approved for purposes of war than any other description of vessel, the authority of Pliny, Diodorus Siculus, Athenæus, Polybius, and others, is sufficient proof that vessels of four, five, six, and ten banks of oars were built;—that Alexander increased the number of banks to twelve;—that Philip, father of Perseus, had a galley of sixteen banks; and—that vessels of four and five banks were frequently engaged in war. The triremes, however, were much more numerous than any other class of galleys except those which had only one bank of oars. Themistocles built three hundred triremes for the purpose of carrying on the war against Ægina; and he obtained a decree authorizing the construction of a further, but limited number of these vessels from the

B.C. 450.

[1] Thucydides (Bloomfield), vol. i. book 1, c. xii. p. 37.

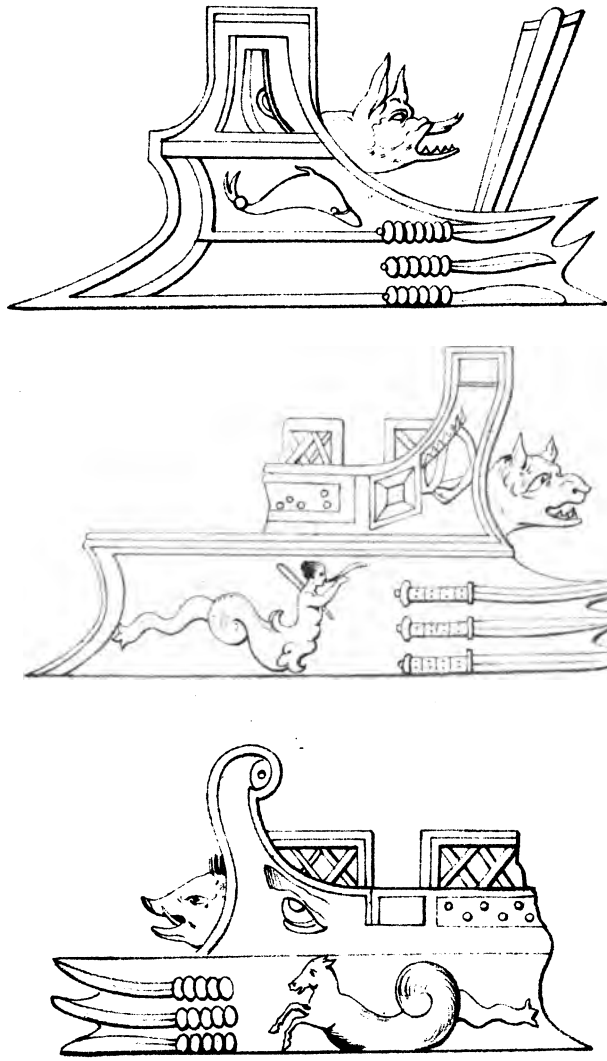
produce of certain mines. After his time, twenty triremes were annually built by the Athenians, so as to maintain in efficient order a permanent fleet of from three to four hundred vessels of this description. Triremes consisted of two classes, fighting ships and transports. The former were propelled at great speed frequently reaching seven to eight miles an hour; the average number of rowers employed on each, varying from fifty to two hundred. The transports were bulkier and stronger vessels, and, though armed, were not brought into action except in cases of urgent necessity.

B.C. 431 to 404. No mention is made of any vessel with more than three banks of oars having been employed in the Peloponnesian War, but quadriremes and quinqueremes

B.C. 400. were known, in the reign of Dionysius I., of Syracuse,

B.C. 255. and were employed by the Carthaginians, in the first Punic War, who had also in their service some vessels of the hexireme and septireme class. From the ease, however, with which the Romans captured these large vessels (even allowing for their superior energy and vigorous mode of close action), they were evidently much less efficient in proportion to their size than triremes. Nevertheless, according to the testimony of Plutarch, very large galleys were in high favour with Demetrius Poliorcetes, whom he represents as a prince possessing superior knowledge of the arts, and of a highly inventive turn of mind. That prince, he states caused several of fifteen and sixteen banks to be built, he himself superintending their construction; and so formidable are these vessels said to have appeared, that Lysimachus, when he had ocular confirmation of reports he had heard of their strength and capacity, raised the siege of Rhodes rather than encounter them

Fig 2.



in action. Plutarch also states that Anthony possessed a fleet of no less than five hundred armed vessels, magnificently adorned, having eight and ten banks of oars, and that he selected the best and largest of them for the celebrated battle of Actium. However exaggerated some of the accounts preserved of these very large galleys may be, and however imperfect and inconsistent the descriptions of them by ancient authors, their existence has been established beyond all doubt.

Their outfit.

With reference to their outfit, it is sufficient to state that, in nearly every instance, they were highly ornamented with figures carved on the bow and stern. Below the bow, and between it and the fore foot or keel, there was generally a projecting piece of very strong timber, to which was attached either a ram's head, sharp metal bolts, cleavers, or some other instrument of destruction. These beaks were at first constructed so as to be visible above the water, but afterwards they were immersed, like the beaks of the iron-clad rams of our own time, themselves evidently copies from original Grecian and Roman designs. The most trustworthy illustrations of these have been taken from the Trajan column and a few coins of the period, of which the drawing on the opposite page (Fig. 2) exhibits a fair representation. Nearly the whole of the ancient war galleys had their bows and sterns considerably elevated above the level of the deck. From the former, or the "*coursier*"—centre platform—an officer regulated the duties of the rowers; whilst the pilot directed, from the quarter-deck, the course of the ship. In many cases, this officer sat under a highly ornamented canopy, from which he issued his commands, and, behind it, there

Beaks and rostrums.

Stern.

was usually carved the image of the tutelar deity of the galley. From the flag-staff floated her ensign or private signal; and, sometimes, a large vane on the taffrail pointed out the direction of the wind. In the column of Trajan a lantern is shown suspended close to the stern in one of the galleys. Each trireme carried two wooden ladders and three "spreads," poles of different lengths. Although the oars were the chief means of propulsion, almost every vessel above a trireme had either one or two masts, but one of them, from raking forward, and being comparatively small, resembled in many respects a bowsprit, so that, practically, there was only one mast, except in very large vessels, which, with the yard and square sail attached, usually completed their rig. The portion of the mast immediately above the yard formed a "top," or structure similar to a basin, serving for the purpose of a look-out or a place from which arrows or other missiles could be discharged. All the Athenian galleys had square sails only, as may be seen in numerous illustrations; and it is very questionable if any of the Greek vessels used topsails of a triangular form, Δ, though they were known to the Romans; but, from their form, the wide part being attached to the yard and the point reaching the topmast head, they could, under any circumstances, have been of very little service, and none whatever when the wind was abeam or before the beam.

Masts and Sails.

The oars varied in size according to the bank on which they were used, of course increasing in length as they ascended. Their length in a trireme is stated at from 9 to $9\frac{1}{4}$ cubits, but no mention is made of the part of the vessel to which they belonged. An

Oars.

oar, however, of only 14 feet in length could have been of no service, unless used on the lowest rank and almost on a level with the water. Those employed in the smallest wherries of the Thames are from 12 to 14 feet long. Thucydides,[2] in describing the attack of the Peloponnesian commanders on the Piræus, the harbour of Athens, remarks, "The plan was that each sailor should take with him his oar, his cushion and his thong, and go by land from Corinth to the sea over against Athens, and proceeding with all speed to Megara, should put off with forty triremes which happened to lie at Nisæa, their naval station, and sail immediately for Piræus." From these remarks it may be inferred that none of the oars belonging to a trireme were of greater weight than one man could carry for a distance of four or five miles; and that only one man was stationed at an oar, unless "his oar" might be construed as meaning the oar under his charge. But though no mention is made of different-sized oars having been used on board of a trireme, there can be no doubt that the oars of the ancients differed far more in size than those of the river barge or man-of-war sweeps, as compared with the sculls of the Thames wherry of modern times.

This is clear from the fact that while various ancient writers mention oars of $9\frac{1}{2}$ cubits in length, Athenæus distinctly states that the oars belonging to Ptolemy Philopater's large ship were 38 cubits long.[3] Here we have a specific account of oars varying from 14 to 57 feet in length, the latter requiring to have

[2] Vol. i. book 2, c. xciii. p. 512 (Bloomfield).

[3] Athenæus, book 5, c. xxxvii.

lead embedded in their handles as a counterpoise to the weight outside the rowlock.[4] Besides it is clear that the oars must have increased in size according to the banks on which they were employed. In the case of the oar 57 feet in length, if worked from a great height a very large portion of it would require to be inboard—say 19 feet against 38, and even the one-third would not, at a line of 9 feet above the water, be sufficient as a counterpoise, unless the shoulder of the oar were of unwieldy thickness or heavily weighted by lead. In all single-banked vessels the oar worked on the gunwale, and was kept in its place by means of a leather thong. In larger galleys it passed through an oar-port. Various ancient writers assert that there was only one man to each oar, and add that he sat, when rowing, on a single bench or small stool attached to the ribs of the vessel, and within a very short distance from the *scalmus* of his oar. It would, however, be altogether impossible, under any circumstances, for one man to handle an oar fifty-seven feet long; and no man *seated* within a couple of feet of the side could work even a fourteen-foot oar to advantage, or indeed at all.

Mode of rowing.

But these assertions, though they increase the difficulty of solving the intricate problem of how galleys, with more than one bank of oars, were propelled, can have no weight when opposed to practical experience. It is clear, without any testimony beyond our knowledge of the physical power of man, that no one man, however herculean, unless he had the aid of machinery, of which there is no proof,

[4] Athenæus, book 5, c. xxxvii.

could work an oar in the manner described. Therefore, without searching for proofs in support of these views, we may dispose of this part of the subject by remarking that in ancient galleys of every description, above the smallest uniremes, more men than one *were* frequently employed upon the same oar. Such was the case in the celebrated Liburnian galleys, already described. Indeed, Pliny distinctly states that the galley of Caius had forty oars on each side, and five rowers to each oar. And from the writings of Suetonius it appears that the galley built for Caligula had no less than eighty oars on each side, with "ten men to an oar,"—in all, sixteen hundred rowers.

Here the question arises how many men could, with convenience, sit on each bench? Presuming that, in the case of an oar fifty-seven feet in length, one-third, or nineteen feet, should be within board, there would, allowing fifteen inches for each rower, be space for fifteen men to work at the one oar; and if the men who sat within six feet of the row-port were of no service, there is still ample space left to place ten effective rowers. Although various interpretations may be put on the poetical language of Homer, and it is not easy to understand what is meant by some of his references to the mode of propelling galleys in his day, nevertheless, five men would appear then to have been frequently stationed at one oar, seated on benches seven feet in length, and, in all such cases, the handle of the oar, for the effective working of the galley, required to be twelve feet in-board from the row-port.

In comparatively modern times, when rowers were

by no means crowded, eighteen inches for each was considered more than sufficient, and there can be no doubt whatever that five men to an oar was far from an unfrequent practice in manning the state galleys of the Italian Republics. But while there is no difficulty in understanding how five or even ten men could be rendered serviceable in working the oars of single-banked galleys, a great difficulty arises when we inquire how that number of men did effectually handle the upper bank oars of the quadriremes and quinqueremes. On these and on many other matters, the accounts of the ancients are conflicting: nor do the imperfect illustrations on ancient monuments and on coins materially assist in the elucidation of some of these intricate questions. Assured of the fact that there were many vessels of much larger dimensions than even quinqueremes propelled by oars, we have to consider *how this was done.* Now the only mode of arriving at correct conclusions on this, the most conflicting and intricate of all the problems connected with shipping, which ancient authors have left for solution, is to trace the progress of the galleys themselves, from the single-banked galley or unireme upwards.

Single-banked Galleys.

With the exception of the extraordinary Liburnian galleys, of which a drawing has already been furnished, every account extant leads to the conviction that the single-banked galleys of the Venetians and Genoese resembled in some respects the galleys of the Romans and ancient Greeks. Drawings of these Venetian galleys, to which references will hereafter be made, have been preserved, but, as no detailed account of them exists, we are obliged to seek

for information from a writer of comparative modern date.[5]

In its leading features, the French galley, constructed somewhere about the close of the seventeenth century, would appear to have resembled those of Venice and of Rome of a similar class. She is described as having been one hundred and fifty feet long and *fifty feet broad;* but there is evidently a mistake in the description of her width, as there is no record of any war galley, either ancient or modern, where the length was only three times the breadth of beam. They were invariably from five to ten times longer than they were wide. All writers on the ships of the ancients or of the middle ages are agreed upon this point; nor is there any account of a vessel propelled by oars of our own time, which was not at least six times longer than she was wide; therefore, it may be safe to assume that the French galley of one hundred and fifty feet in length, did not much exceed thirty feet in width. In other respects, with the exception of the length of oars, the description of this single-banked galley is evidently quite reliable. French Galley.

The author says, that she "consists but of one deck, which covers the hold; this hold is in the middle nine feet, but at the sides of the galley only six feet high. By this we may see that the deck

[5] In the 'Monthly Magazine,' vol. xviii., London, 1758, p. 445, there is a review of a work, entitled the memoirs of a Protestant condemned to the galleys of France, written by himself, which contains, in minute detail, a description of a French galley in which, in the year 1701, he was condemned to labour. The account was originally published at the Hague, and was afterwards translated into English, 2 vols. 12mo.

rises about a foot in the middle, and slopes towards the edges to let the water more easily run off; for when a galley is loaded, it seems to swim under water, at least the sea constantly washes the deck. The sea would then necessarily enter the hold by the apertures where the masts are placed, were it not prevented by what is called the coursier. This is a long case of boards fixed on the middle or highest part of the deck, and running from one end of the galley to the other. There is also an hatchway into the hold, as high as the '*coursier*.' From this superficial description, perhaps, it may be imagined that the slaves and the rest of the crew have their feet always in the water; but the case is otherwise, to each bench there is a board raised a foot from the deck, which serves as a footstool to the rowers, under which the water passes. For the soldiers and marines, there is, running on each side along the gunwale of the vessel, what is called a *bande*, which is a bench about the same height with the *coursier* and two feet broad. They never lie here, but each leans on his own particular bundle of clothes in a very incommodious posture. The officers themselves are not better accommodated, for the chambers in the hold are designed only to hold the provisions and naval stores of the galley."

The author then proceeds to state that the French galley had a chamber in the poop or raised deck, only large enough to hold the captain's bed; that, contiguous to it, were compartments for the more valuable stores; and, after remarking on various details, he adds, that she had twenty-five benches for the rowers on each side of the vessel. These fifty

benches, which were four feet apart, and ten feet long, are described as having been "covered with sackcloth, stuffed with flocks, and over this is thrown a cow-hide, which, reaching down to the *banquet* or footstool, gives them the resemblance of large trunks. To these the slaves are chained, six to a bench; along the *bande* runs a large rim of timber, about a foot thick, which forms the gunwale of the galley. On this, which is called the apostic, the oars are worked. These *are fifty feet long*, and are poised in equilibrio upon the afore-mentioned piece of timber, so that the thirteen feet of oar which come inboard are equal in weight to the thirty-seven feet outboard; and as it would be impossible to hold them in the hand, because of their thickness, they have handles by which they are managed by the slaves."

If the oars of this vessel, which in their leading features no doubt resemble those of the large single-banked galleys of the ancients and of the middle ages, were fifty feet in length, then a beam of thirty feet would not suffice for oars of that enormous length. But if the beam was only one-sixth of her length, we may assume that the oars were not more than thirty-nine feet long, especially as that length would be amply sufficient for propelling a single-banked vessel. In that case the oar would be thirteen feet inboard as described, affording abundance of space for six slaves to be stationed at it, although the two nearest the side would be of comparatively less service in rowing. To enable the rowers, and especially those who were stationed nearest the centre of the galley, to work with effect, their benches must have been placed in a slightly oblique position.

From this description, there is no difficulty in understanding the character of the uniremes; it is only when we come to inquire what was meant by biremes, triremes, and so forth, and how they were propelled, that the most conflicting statements are met with. Although Scheffer, General Melvill, and others, have bestowed an immense deal of learning in their endeavours to prove that each oar was rowed by one man only, and that the banks were placed directly one over the other, the bulk of the testimony of ancient writers, confirmed by experience, is opposed to any such views. Nor does the order of the Emperor Leo, which they quote, that "every ship of war must be of its due length, having two banks of oars, the *one higher* the other *lower*," favour their opinion. Indeed, "one higher the other lower" is more likely to refer to oar-ports placed in an oblique rather than a vertical line.

But, apart altogether from these conjectures, the most casual inquiry will show, that it would be impracticable to row any galley with more than two banks of oars on the plan suggested. For instance, if only two feet be allowed for the space between the lowest port and the water, and not more than five feet intervenes between it and the *scalmi* of the second bank of oars, the rowers on that bank would be seven feet above the water line. Admitting that a bireme could be conveniently rowed by oars of sufficient length at this height, it would be impossible to do so at twelve feet above the water line, where the third bank of rowers would be seated. But a space of five feet between the lower banks, making no allowance for the thickness of the deck

and beams, would fall far short of what would be required for the men who worked the upper banks, the angle of their oars increasing with the ascent, and consequently requiring much greater height between decks for their motion. Every additional rank adds to the difficulty in a greatly increased ratio; and, if hexiremes were efficient ships, which, on the authority of Polybius they were,[6] it would have been altogether impracticable to propel them by oars on the plan suggested.

General Melvill's theory.

It might be unnecessary to offer any further remarks upon the impracticability of this theory, had not Mr. Mitford, the celebrated historian of Greece, expressed so strong an opinion in favour of it. "The most satisfactory conjectures," he remarks, "that I have met with by far, are those of General Melvill."[7] It may, however, be here explained that General Melvill, in common with other writers on the subject, had previously entertained the opinion that the number of banks were measured by the number of men at an oar. That is to say, a unireme, he considered, had only one man placed at an oar, a bireme two, a trireme three, and so forth, up to the great ship of Ptolemy Philopater, which had, according to this theory, forty men to each of its fifty-seven feet oars. As the General on examination found such a theory to be untenable, he conceived the idea that in no case was there more than one man to an oar. "He," then,[8] "set himself to investigate the subject for confirmation of this opinion on fact, as he should find

[6] Book 1, cap. xxiii.

[7] 'History of Greece,' vol. ii. p. 194.

[8] Pownall's 'Treatise on the Study of Antiquities,' Appendix, no. iii. pp. 236-240.

that fact to turn out in the descriptions of sea-fights and other naval transactions, as given by the ancient authors, particularly Polybius, Cæsar, Livy and Florus." Impressed with his new idea, it occurred to him, that "the indispensable requisites were, that in the arrangement of the rowers within, each side ought to have been such as to admit of the greatest number possible, that they should be so placed as not to impede each other; that they should be enabled to row to the best advantage; and that the highest tiers, both in respect to length and weight, should be sufficiently manageable: from these grounds the discovery immediately resulted to him, which was, that by a combination of two obliquities between the galley and a rowers' gallery running along its waist part, projecting outwards from a small distance above the water's edge, with an angle of 45°, and rows of horizontal seats of about two feet in length, fixed obliquely upwards from the bottom of this gallery, against this obliquely projecting part of the side, with no more space betwixt them in all directions than should be found necessary for the free movement of men when rowing together, a quincunx or chequer order would be formed, with all the above-mentioned requisites, to the highest degree of advantage which could co-exist consistent with each other."

It is not easy to understand the General's scheme by this description of it. He lays down, practically enough, some essential points, which require to be considered; but while the oar adapted for the lowest banks might be "sufficiently manageable," the oars of the upper banks, even if well balanced, could not

be effectively worked by one man. Nor is it easy to understand, what is meant by "rows of horizontal seats, of about two feet in length, fixed obliquely upwards from the bottom of this galley;" however, the General caused a model of a quinquereme to be erected against a high wall belonging to his house in London, which was of the same proportions as would have been required for a "fifth part of a real galley." The model is said to "have held, in a very small space, but with sufficient ease, the rowers of five tiers, of six men in each, lengthways, making one-fifth the rowers on each side of a quinquereme, according to Polybius, who mentions three hundred as the whole number of rowers in it, besides one hundred and twenty fighting men." But this further explanation does not assist in the elucidation of his theory of "one man to each oar." On the contrary, it rather tends to confuse, unless the General means that there were one hundred and fifty row-ports on each side of the quinquereme mentioned by Polybius, which would be absurd.

But the practicability of the whole plan is shown when an examination is made of the space that would be required to place, single file, three hundred rowers at the oars of a quinquereme.

The sweep of an oar is measured by its length, and would require a certain defined space for its movement, irrespective of the number of men at work upon it. The single-banked French galley already described, was one hundred and fifty feet long, having twenty-five benches on each side, requiring a length of one hundred feet. All other accounts, as well as experience, show that the benches were, and

required to be, three feet apart; and, allowing one foot for the breadth of the bench, each oar would require a space of four feet in a horizontal line. According to the General's theory, there would be thirty oar-ports on each bank, which, allowing for their obliquity, would require the gallery attached to the side of his galley to be somewhere about two hundred feet in length for the accommodation of the rowers. No doubt such a vessel could be built, but it is very questionable if any such vessel *ever was built*. Ptolemy Philopater's ship would have required to have had two thousand oar-ports on each side, to afford employment to her rowers. There is, however, an equally valid objection to the General's scheme: a bank of oars means something whereby one class of galleys could be clearly distinguished from another class. Ships of war, up to a comparatively recent period, were rated as mounting so many guns, just as ancient galleys were rated by their banks of oars; the one measured the fighting, the other the propelling power. But if, according to the General's plan, triremes or quinqueremes were known by the number of banks, what was the measure of vessels of a larger size? for he does not profess to work any galley on his plan with more than five tiers; nor can he maintain that the size of his galley was measured by the number of her oars, which would depend upon her length. In whatever way this scheme is examined, it will be found to be untenable.

Charnock's theory.

Charnock, in his 'History of Marine Architecture,'[9] has devoted evidently more space than thought

[9] Vol. i. p. 47.

to the elucidation of this intricate subject. He says, "After reading the various treatises written with a view of elucidating this subject,—after viewing the different designs collected with much care from the Roman antiquities for the same purpose, though they afford us in themselves nothing decidedly satisfactory,—we may boast of having, in some measure, developed from them, if not the absolute truth, at least a reasonable system of explanation." "This," he continues, "has been a matter of no small difficulty; these learned dissertations and investigations, compiled chiefly from the labours and evidence of ancient sculptors, who attended neither to exactness nor proportions, are extremely contradictory, and it is very evident that, for the most part, they convey to us a very false idea of the galleys of ancient times." Charnock, however, does not seem to have solved the difficulty. While he, with all other writers on the subject, accurately describes "uniremes" as "those galleys or vessels which had only one row of oars extending between their masts, or perhaps the entire length of the vessel," he breaks down at the first step beyond a unireme, when he says that "the biremes had one tier of oars between their masts, and another abaft the main or principal mast." Indeed, all theories must necessarily fail, which cannot be made applicable to vessels of every description; and it is no solution of the difficulty to deny, as Mr. Charnock and others have done, the existence of vessels beyond a certain size, when it is found that a theory practicable within certain limits, would be altogether impracticable if carried beyond them.

That this would be the case in Mr. Charnock's plan he himself admits. He says that a trireme was a galley more formidable than the bireme, "having one tier of oars extending between the masts, a second abaft the mainmast, and a third forward, near the prow or stem before the foremast." The quadriremes, he describes as having had "their oars ranged like the triremes, with the difference of having two tiers of oars, one above the other, abaft the mainmast." "The quinqueremes," he adds, "were also of the same description, with the addition of the second tier of oars forward." He then goes on to state that "the octoremes had two tiers of oars in the midships, and *three* at the stem and stern, making in all eight." This is no doubt an easy method of solving the difficulty, so far as regards biremes, triremes, quadriremes and octoremes, but our author fails to explain how his principle can be applied to vessels of a larger description, or even how the number of rowers each of these classes are said to have contained, was placed at the oars. The latter he does not attempt, and as summarily dismisses the former by questioning the existence altogether of any vessels with more than three tiers of oars placed either directly or obliquely above each other. He does so on the ground "that while from the evidence of a multitude of ancient sculptures," the fact is established of the existence of vessels with three tiers, "there is no certain proof of any having been constructed with a greater number;" adding that even vessels of the octoreme class "were enormous floating structures, built merely for the purposes of luxury and to gratify a ridiculous

ostentation, so unfit for war, or even navigation, that they could not venture to sea without manifest danger."

Although Mr. Charnock is of opinion that "the foregoing explanation appears perfectly simple and conformable to reason, and enlarges our idea of the marine or naval force of the ancients," it certainly will not satisfy strict criticism. There is no reason to suppose that vessels of the octoreme class were very numerous at any period of history, but that these and others still larger, were constructed for purposes other than the gratification of "a ridiculous ostentation" there is ample evidence. However, the theory which Mr. Charnock considers unanswerable, would not be the most perfect in practice, even in vessels of an inferior class to the octoreme. The oars would be more effective in midships than at any other part of the vessel, yet our author places the greatest number of these aft and forward, *near* "the prow or stem, near the stern." If there is any merit in his scheme, it would consist in placing the *three* banks in midships, and one aft in the case of a quadrireme; one aft and one forward in the case of a quinquereme; and two instead of three near the "stem and stern."

Vossius, his views.

The whole of the question of rowing ancient galleys has been exceedingly well put by Vossius, in his 'Dissertation on the Ancient Marine.'[10] Speaking of the largest of all these ships, of which any record remains, he says, "If we compare the oars that must necessarily have been used on board of

[10] Extracts from Charnock's 'History of Marine Architecture,' vol. i. p. 52.

this (Ptolemy's) ship, with those by which the modern galley is worked and allow for their different proportions in respect to length, we must also keep in view a similar comparison in regard to their size and thickness, and we shall then have a correct idea of their relative dimensions, as well as their strength." He then goes on to remark, "Let us now consider in what manner the four thousand rowers which are said to have been employed on board this vessel, were employed or stationed at the forty banks of oars. It is not my intention," he continues, " to combat or examine what many learned men have already written on this subject, both in France and in other countries. Their opinion is certainly correct in respect to the tiers of oars being placed obliquely over each other. Existing remnants of antiquity convince us clearly of the fact; but there still remains a much heavier difficulty to be got over: it is, in what manner the oars of the upper tier could be worked and managed by one person only, for it is denied that more than one was stationed to each oar, and the perplexity of the enigma is not a little increased, by the assertion that a very small part of the oar reached within board. It is well known that there are no weights whatever which, by the proper assistance and combination of mechanical power, may not be moved even by a single person; but we are at the same time certain, that the greater the weights are, so much the slower can they be moved. Oars, it must be remembered, become almost useless, unless they are impelled with quickness and spirit, as well as brought back to their original station, for a renewal of the stroke with

equal celerity. The mechanical powers are of no use in this instance, as the law remains fixed and immutable, that any operation, which, in the ordinary course of things, requires ten men to perform it, and one only is employed, may indeed be executed by that one, but will require a period ten times as long to perform it in; for nature will not suffer herself to be deceived, or her laws perverted by any such vainly-hoped-for advantage."

While Vossius was of opinion that no vessel had ever more than seven tiers of oars,—though he does not show how that number could have been worked,—he, for the reasons just quoted, arrived at the conclusion "that in the lower tier one man only was stationed to an oar, which being short, and but trivially elevated above the surface of the water, he might be able to work without much difficulty." He then explains that, in his opinion, as to which there can be no question, "the oars in all superior tiers, as they increased in height from the water, increased also in length, within board as well as without, leaving room for a greater number of rowers to work, each in progressive proportion to their length;" but he draws a false conclusion from right premises when he remarks that the difficulty consists "not in so many tiers, but in the number of seats for rowers comprised in one oblique tier."

Such are the views of a few of the leading writers on this intricate question. While agreeing with Vossius in the opinion that the oar-ports were placed obliquely in the sides of the vessel, and that the number of men to an oar was regulated by its length and position, there are numerous objections to his theory

that the galleys of the ancients were classed, either by the number of men or by the number of their seats; and any seaman who takes the trouble to put the theory into practice will find that even the principle of obliquity will not admit of the effective working of more than five tiers of oars.

Each theory, however, contains less or more truth; and by a careful examination of the whole, the problem which has occupied the attention of so many writers may be successfully solved, if a little common sense be substituted for opinions expressed evidently for the purpose of harmonizing with statements made by ancient authors, who did not practically understand the subject, or whose writings have been misquoted or imperfectly interpreted. All writers agree in the opinion that the uniremes had only one bank or tier of oars, and there is no difference of opinion in regard to the mode of propelling these vessels. Although "seated," [and this expression has led to much controversy], the rowers, in the case of large vessels, doubtless, rose simultaneously to their oars at the word of command, stretching out the handles as far as the allotted space would permit, and then throwing themselves back uniformly upon their seats, and, with their whole weight, propelling the galley forwards. This mode of rowing may be seen in the Mediterranean and elsewhere at the present day.

Writers differ in regard to the number of men placed at an oar; but, herein, there is, practically also, no difference of opinion, for the number of men at an oar would depend on the size of the vessel. A jolly-boat has never more than one man at an oar, but a launch has two, and, in the phraseology of our

own time, launches thus rowed are called "double-banked," although this does not seem to have any connection with the vessels of two tiers of ancient times. Nor is there much difference of opinion in regard to what was meant by a bireme. It has been said, it is true, that a bireme derived her name from her oars being double-banked, but this theory may be dismissed, as it would not apply in practice in the case of very large vessels. Apart, therefore, from direct testimony there seems little doubt that a bireme meant a vessel, not with two rowers to an oar, but with two banks or tiers of oars. Some writers, as already explained, have maintained that the oar-ports were placed directly one above the other. No doubt biremes could have been propelled by oars working in the manner thus suggested; but those persons who have carefully examined the Trajan column, as well as other remnants of ancient sculpture, assert that these afford positive proofs of the oars having been placed *obliquely* over each other; and, on the coins of the reign of the Emperor Gordian, two tiers of oars placed in this fashion are very conspicuous. If, however, any doubts still exist on this point, they are entirely set at rest by the recent discoveries of Layard and others.

The frontispiece is a copy of an alabaster slab found at Kouyunjik—the probable site of ancient Nineveh. Nothing can be more distinct. It clearly shows that in ancient times the oar-ports were arranged obliquely on the broad side of the galley. The next question for consideration is, not merely to what extent this principle could be applied, so as to

place at work the vast number of rowers which some galleys are said to have carried, but also to afford accommodation for the troops and stores embarked on board of them.

Mr. Howell's plan.

Mr. Howell, a comparatively modern writer,[11] adopts many of the views of Vossius, differing from him, however, in the number of banks, and maintaining that it would be impossible to work with effect more than five. As his views are much more in accordance with our own than those of any other writer, we shall refer to them at greater length, although differing also from him in some of his most important conclusions. Here, however, it may be remarked, that every modern writer, Mr. Howell included, appears to have given too little consideration to the facts, that ancient galleys varied quite as much in size as the vessels of modern times, that their power or dimensions were not, in all cases, measured by the number of their banks of oars, and that in proportion to the number of rowers the capacity of the hold would require to be increased. A war-galley would be comparatively useless if she had not ample capacity for fighting men, their munitions of every kind, besides stores, including water. All these points must, however, have been fully considered by the ancients, and they would see that when they wished to have more than thirty oars on each side of a galley, they could not increase the number on the single-bank principle without constructing her of an unwieldy length, in proportion to her depth and breadth, and sacrificing an unnecessary large amount

[11] 'An Essay (pamphlet) on the War Galleys of the Ancients.' By John Howell. Published by W. Blackwood: Edinburgh, 1826.

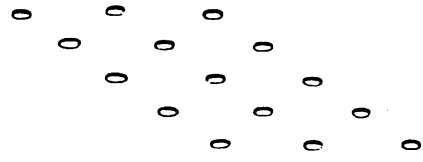
of space. Consequently, they invented the bireme, whereby they could, in very little more than the length required for fifteen oars, place double that number without any corresponding sacrifice of space. Applying this principle to the trireme, they would in the same length obtain space for three times the number of oars, and secure for the use of the soldiers and stores any extra length they might think proper to add to their galleys.

Mr. Howell, in discussing the principle as applicable to quinqueremes, shows that by adopting the oblique ascent, the rowers of the first and highest bank are placed so as not to interfere with the rowers, forming the second bench, their oars having space to play free of the benches before them. "That a bank or bench of oars," he adds, "never contained more than five oars, I think, can be proved, whatever the size of the galley was, whether a bireme or trireme, up to the galley of Philopater, which had forty banks, nine feet being the highest point from the water for the *scalmi*, from which they could pull with effect."[12]

Mr. Howell, in confirmation, as he conceives, of this opinion, quotes Athenæus (book v. chap. 37); but, though we cannot find anything in this ancient writer's description of the great ship, to lead to the conclusion that the *scalmi* of her highest bank of oars were not more than nine feet above the level of the water, we agree with Mr. Howell in the opinion that an oar could not be worked effectively at a greater height, and that the seats of the rowers were arranged by the system of obliquity, so as not to interfere with each other. We, however, differ from him in other

[12] Howell, Pamphlet, p. 48.

respects. "A Greek trireme," he remarks, "at the time of the invasion of Xerxes, had from one hundred and fifty to one hundred and sixty rowers and forty armed foot, while the average-sized Persian triremes carried two hundred rowers and thirty soldiers." Presuming these to be established facts, Mr. Howell endeavours to make his theory harmonize with them. "I have shown," he says, referring to the French vessel, of which we have furnished particulars, "that a modern galley pulling fifty oars has six rowers on a bench. If I am correct," he continues, "a trireme pulled thirty oars, that is, three banks, five oars in each, thus:—



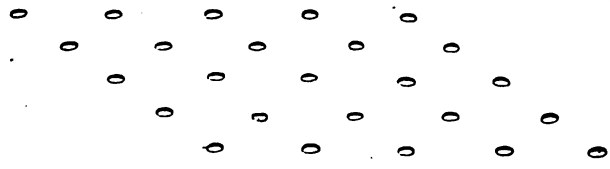
"Now, to a vessel of her bulk, with elevated poop and stern," he goes on to state, "less than five men cannot be allowed to each seat. Thus there are twenty-five rowers in each bank, and six times twenty-five make one hundred and fifty." But though this mode of calculation—which, by the way, does not allow for any "watch-and-watch" or reliefs[13]—makes

[13] Although Homer—Book 13th—states that Ulysses was rowed from Corcyra (Corfu) to Ithaca, a distance of eighty nautical miles, in ten hours, there is nothing to show that ancient galleys were propelled *continuously* by their oars, or for a longer period on a stretch than the one set of rowers could endure. To this day the Malay pirates sometimes row more than ten hours without change, and are fed at their oars. Nor is there anything to show that the ancient galleys carried two, much less three gangs of rowers, although they no doubt had spare men for reliefs, in case of accident. But this question, though interesting, does not affect the solution of the problem now under consideration.

the Grecian galley agree with his scheme of manning her, so far as regards the number of rowers, it is based upon the presumption that the same number of men were placed on each of the oars. This is evidently a fallacy. While five men might be placed to advantage on each of the upper tier of oars, two of them, at least, would be useless on the lower tier in a vessel of this size, even if they could find space to work at it. The same fallacy runs throughout the whole of his argument when he endeavours to bring his views in these matters into harmony with the imperfect and frequently conflicting descriptions of ancient authors. Thus he accounts for the Persian trireme with her two hundred men, by saying that she "must have had six men to an oar, which is not improbable, the Asiatics being not so athletic as the Greeks. Six times thirty," he adds, "is one hundred and eighty, leaving twenty men for casualties, etc. etc."

This is an exceedingly easy mode of attempting to solve an intricate question; but Mr. Howell, instead of overcoming the difficulty, only increases it when he says that there must have been six men to an oar, for six men would be less easily placed at each of the lower tiers of oars than five. Nor does he aid in the solution of this vexed problem when he comes to deal with vessels of five banks. Practically his arguments are the same, but it will be interesting and instructive to quote them, as showing the mistakes which learned men are liable to make when dealing with questions which can only be solved by combining learning with experience, and how complacently they arrive at the conclusion that they must

be right and everybody else wrong when their figures are made to correspond with certain figures quoted by ancient authors. "Polybius," remarks Mr. Howell, "informs us the crew of a quinquereme was three hundred rowers and one hundred and twenty fighting men. Now a quinquereme," he reasons, "having five banks, thus,—pulled fifty oars, or twenty-five



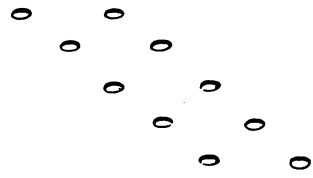
aside, the same number as the modern galley. As by this arrangement, adding to the banks of the galley," he continues, "did not add to her height, and not in any great degree to her length, seven feet being sufficient for a bank, I think the addition of one man to an oar was all she could require. Six times five is thirty, and ten times thirty, three hundred. Both of these," he concludes, with evident self-satisfaction, "are remarkable coincidences, and tally better with the description of ancient authors than any solution that has yet been given."

"I shall now," he continues, "show how remarkably it agrees with Athenæus; thus taking in the whole range and applying to all, a thing it could never do were it not near the truth. The tesseraconteres having," he adds, "forty banks, five oars to a bench, makes her have two hundred oars of a side, or four hundred in all. Considering her size, she could not have less than ten men to an oar." The Liburnia of Caligula, according to the testimony

of Suetonius, had, he states, that number of men to an oar, forgetting, that she was a single-banked galley, and consequently he comes to the conclusion that that number was attached to each of the four hundred oars in Philopater's ship, which "gives four thousand, the number mentioned by Athenæus." Here again he overlooks the greatly increased difficulty or impracticability of placing ten men at each of the lower tier of oars.

Our own views.

Now, while there can be no doubt that all vessels had their ports placed obliquely in cases where there were more than one tier of oars; that there were vessels of five tiers of oars thus placed and no more, and that the Grecian trireme had one hundred and fifty rowers, and the Persian two hundred, it is clear from the descriptions of ancient authors that there were many triremes of much smaller dimensions, especially from the facility with which they were hauled upon the beach: while there were, no doubt, others carrying even more men than the galleys he refers to.[14] But presuming Mr. Howell to be correct in his supposition, that a trireme derived her name from having three rows of five tiers and no more, as he illustrates, then a bireme would derive her name because she had only two rows of five tiers, thus:—



[14] Thucydides (Bloomfield), vol. i. cap. xciv. p. 514, etc., etc.; and vol. i. pp. 30 and 32.

Biremes. No practical man, however, could entertain the idea that ten oars arranged as he suggests would be equally efficient to a similar number in single lines or even in double tiers; nor would a galley of this size be nearly so efficient as she would be with her ports in a horizontal line, for she would be much too high in proportion to her length. Similar remarks apply with nearly equal force in the case of triremes.

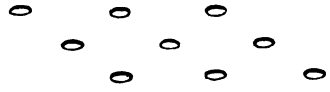
The perusal of ancient authors, as well as experience, leads to the conviction, that galleys from the unireme to the quinquereme inclusive had their oars arranged not merely in oblique vertical rows, but also in horizontal rows, according to circumstances. Besides, the plan illustrated on the Nineveh marble is much more practicable than the one suggested by

Triremes. the theory of Mr. Howell. A galley with only ten oars on a side would be more efficient if they were placed as follows:—

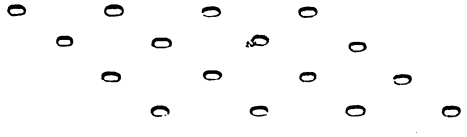
than if arranged in the manner suggested by Mr. Howell. Nor would they occupy more space, the saving of which, no doubt, induced the ancients to increase the number of tiers. It is only, however, when three banks and upwards are applied, that there is any very material saving of space. Thirty oars, for instance, placed obliquely in three rows in midships, would occupy much less space, and would consequently give greater accommodation for troops or stores, than would be the case if the same number of oars were placed in a single horizontal row.

As the galleys of the ancients must have varied

very much in their capacity and dimensions, it would be more reasonable to suppose that, from the unireme to the quinquereme inclusive, they derived their names from the number of oars placed horizontally over each other, rather than from the number of oblique rows as suggested by Mr. Howell. That is to say, though a trireme bore that name because she had three tiers of oars placed thus,



she was, nevertheless, still a trireme, though she had four, five, ten or twenty oblique rows of oar-ports, only she would be a trireme of a larger size, just as we have or had frigates—single-decked vessels, which have varied in size from 600 to 6000 tons. A trireme might therefore be a much more powerful vessel than a quadrireme or quinquereme. On a similar principle, a quadrireme would have four horizontal tiers of oars, as follows:—

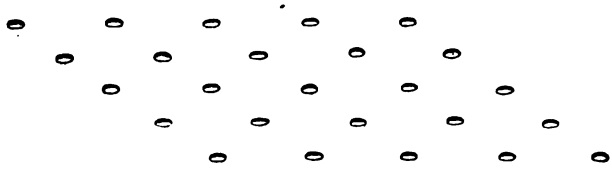


Quadrireme.

but, as in the case of the trireme, she would still be a quadrireme, only of a larger size, if she had more than four oblique rows. There is, however, a limit beyond which oars could not be worked when placed over each other in any fashion. That limit would be reached at the fifth horizontal row, and for the reasons already named, a sixth row, however obliquely placed—for obliquity has also its limits—would be useless. Therefore, while a quinquereme

had five horizontal rows, and the same number of oblique rows forming a *quincunx* thus:—

Quinquereme.



the galley, it would appear, acquired another name when she had *more than five of these oblique rows.* For instance, vessels with six oblique rows were, in our opinion, called hexiremes; with seven rows, septiremes; with eight rows, octoremes, and so forth; up to Ptolemy Philopater's tesseraconteres. That the number of men placed on board the ships of the ancients was regulated as at present by the work they had to perform, and by the size of the ship, there can be no doubt; but the number of men had nothing in itself to do with the class or grade of the galley. In some triremes there may have been frequently not more than fifty rowers, and in others five hundred. Our theory does not require the number of men to harmonize with the number recorded by Polybius, Athenæus, and other authors, to have been employed in the different rated galleys of the ancients. In the trireme, which is described as having thirty oars and one hundred and fifty rowers, it would not be necessary to place five men at each oar, as Mr. Howell has done, to make his theory harmonize with this account. Six men to each of the oars of the highest bank, five to each oar of the second, and four men to each oar of the third bank, would give the requisite number of one hundred and fifty

Hexiremes and larger galleys.

Suggested plan of placing the rowers.

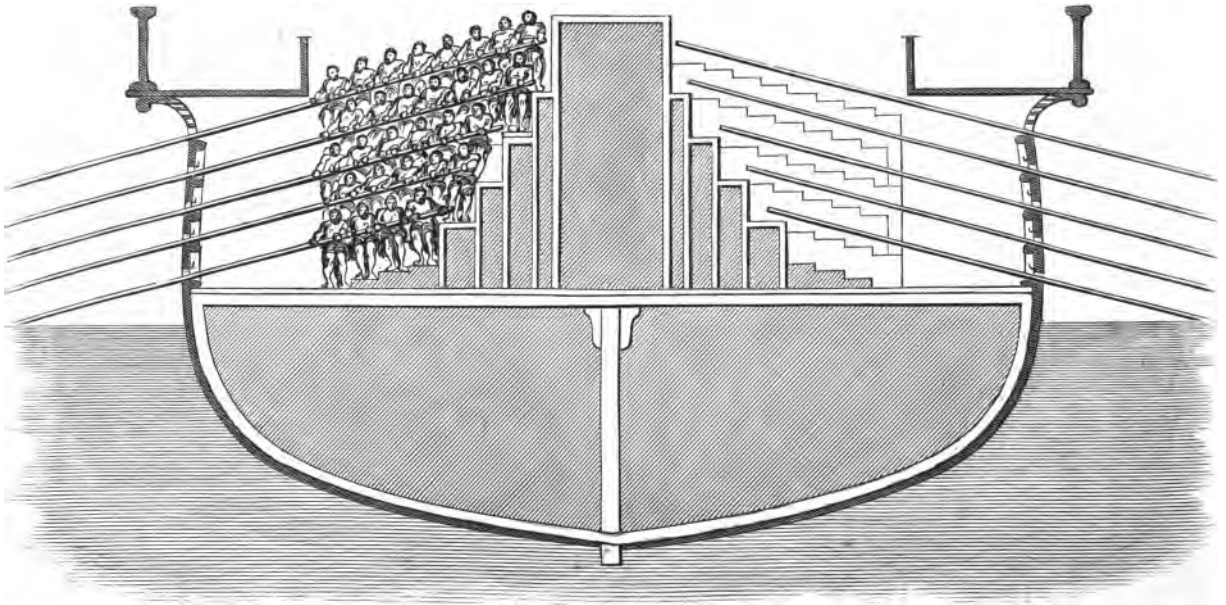


FIG. 3

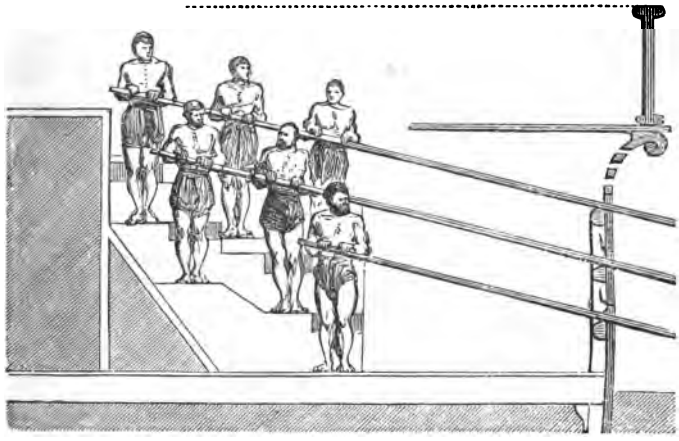
rowers, who would be far more effective than if placed in the manner he describes. In the case of the quinquereme, which, according to Polybius, had three hundred rowers, instead of placing six men, presuming there were no reliefs, to each of her fifty oars, our theory, while it equally solves the difficulty created by the statement of Polybius—a difficulty which could only arise in quinqueremes with so large a crew as three hundred rowers,—is one which could be carried out with much more practical effect; for, by placing on the 1st bank 8 men $\times$ 5=40; 2nd, 7, $\times$ 5 = 35; 3rd, 6, $\times$ 5 = 30; 4th, 5, $\times$ 5 = 25; 5th, 4, $\times$ 5 = 20; there would be 150 on each side, or 300 rowers in all, as represented in the transverse midship section of what a quinquereme really must have been. (Fig. 3.)

Before proceeding to examine in detail how rowers thus arranged could work with effect, it will be desirable to show, that the outline of the vessel, of which a section is here given, corresponds not merely with the imperfect information obtained from ancient authors, but with what would be practically possible. To work the number of men here shown the breadth of the beam of the galley would, presuming every rower on board to be employed at the same time, require to be, at least, forty-two feet, which would allow eighteen feet for the range inside of each of the oars on the upper bank, and six feet for the width of the raised midship deck, where the hatches were placed. That width would allow for oars fifty-four feet in length, which would be ample where the highest row-port was nine feet above the level of the water; and as thirty men would be able to work on each

oblique row, a hexireme, of no greater width, could carry three hundred and sixty rowers, a septireme four hundred and twenty, an octoreme four hundred and eighty, and so forth. In the case of a tesseracontere, with no greater beam, two thousand four hundred rowers could find employment, but as vessels of that enormous size, if more than the one was ever built, were very considerably wider[15],—it would be an improvement on the plan proposed by Mr. Howell, of ten men to each of the four hundred oars, to place fourteen rowers upon each of the oars of the upper bank, twelve on the second, ten on the third, eight on the fourth, and six on the fifth or lowest bank, which would give the required number of four thousand, though, in either case, many of the men would be more ornamental than serviceable. There is, however, no doubt that about three thousand men could be placed so as to row in each individual case with effect if they were apportioned to their oars in somewhat the scale of ten, nine, seven, six, and five, or say, thirty-seven men to each of the forty banks or oblique rows of oars, which would leave one thousand for reliefs.

If the men were arranged in the manner suggested, and as represented in the following front view of their positions when placed at their stations before they commenced work on board of a trireme, the various objections which have been raised to the plan of working oars placed one over the other are removed.

[15] Ptolemy's ship had a beam of 57 feet.

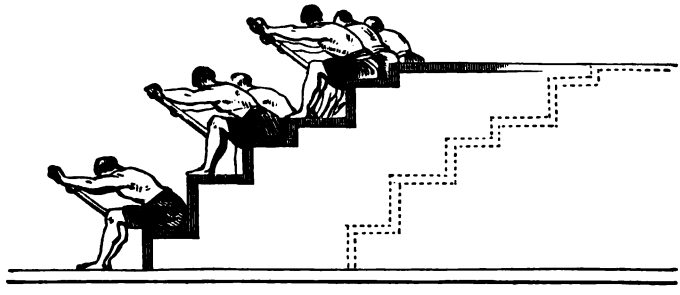


A practised eye will at once perceive that rowers thus arranged could work with great effect and simultaneously, without in any way interfering with the movements of each other. Nor would there be any difficulty in placing to advantage, as may be seen in our illustration (Fig. 3), of the tranverse midship section of the quinquereme, so that each might work with effect, the very large number of three hundred rowers on vessels of that class.

If this can be shown, then the problem is solved as to how the various classes of galleys were rowed, for, if the principle of their classification was in accordance with these views, the difficulty does not increase with their dimensions, which is the case in all other theories; the extreme height of the highest bank of rowers, either in the case of the quinquereme, or in that of any of the larger vessels, not requiring to be more than nine feet above the water.

At the word of command from the officer, who

walked upon the elevated portion of the deck, and guided by the leading men, who were stationed at the inner end of the oars, the rowers, when seated, stretched the handles of their oars as far aft as their arms would permit; as shown in the following representation:—



The action of the rowers would, however, in some measure be regulated by the size of the galley and the space at their disposal. Placed alternately, those who worked at the lower tiers would, in all galleys, have full swing for their oars, as the footstools of the rowers who sat above them would not interfere with the free action of their bodies, though such might appear to be the case by the side representation, which in itself, and without reference to the front view, necessarily fails to show their exact position. But while the men in small galleys rowed from their seats, there is every reason to suppose that in the larger description, where great numbers of rowers were employed, they rose, if seated, as they now do, in the Mediterranean and elsewhere, and after moving one or two steps forward, according to the space at their disposal, they threw themselves backward into their seats with an impetus as simulta-

neous and harmonious as it would be possible to attain without the aid of a machine to regulate their joint action. Indeed, the ancients practised this art with the greatest care, and the rowers were frequently exercised on benches erected on the shore, and their harmonious movements were sometimes made an object of display in their theatres. In nearly every case they plied their oars to the sound of either vocal or instrumental music, so that a fleet of the larger description of galleys, when under weigh on the smooth waters of the Levant, must have been, as various ancient authors describe, a heart-stirring and magnificent display.

Vossius, Le Roy, and all who have written on the subject of how the rowers were placed at their oars, though they differ less or more from each other, and fail, as we conceive, to propound a theory applicable to vessels of every class, agree in the opinion, that the rowers were divided into classes, and that the *thranites*, who pulled the longest and highest oars and had the greatest amount of labour, were exposed to the darts of the enemy. For these reasons they received, as we learn from Thucydides, the highest pay; and from the same authority we ascertain that even the largest description of galleys "were *not* decked *throughout*."[16] These statements are important showing, as they do, a thoroughly organized system amongst the rowers, without which it would have been impossible to make available, in a limited space, large numbers of men, and answering the objections which have been frequently raised, to having so many men at work close together in the

[16] Thucydides (Bloomfield), vol. i. chap. xiv. p. 41.

hold of a ship. By our illustrations, it will be seen that the galleys are only decked somewhat less than halfway across, in midship, a large space remaining open, so that the upper tier of rowers were above the level of the deck, and exposed to the "darts of the enemy," except so far as they, with the soldiers who fought from the sides as well as from those portions of the deck in the bow and stern, which were wholly covered, were protected by the bulwarks. Besides the beams, there were stringers placed fore and aft, constituting gunwales, on which the oars were balanced. The solid framework of the hull does not appear to have extended above the highest bank, and the platforms with the benches on which the rowers sat were either built with the ship or fitted afterwards according to circumstances.

The larger description of ancient galleys were, so far as we are now competent to form an opinion, divided into compartments, as shown in Fig. 4, and were not unlike the steamers of our own day, verifying the old adage that there is "nothing new under the sun;" and certainly this holds true on comparing the bows of the war galleys of the ancients with the iron-clad rams of modern times. Our theory, therefore, after the most careful inquiry and a close consideration of this question in all its details, is, that *the paddle-wheel steamer of to-day is really and practically in her structure* (though materially improved, and possessing the vast advantage of mechanical power) *the row galley of the ancients.* Her machinery and coal bunkers are distinct and separate from the hold, cabins, or any other portions of the ship; and

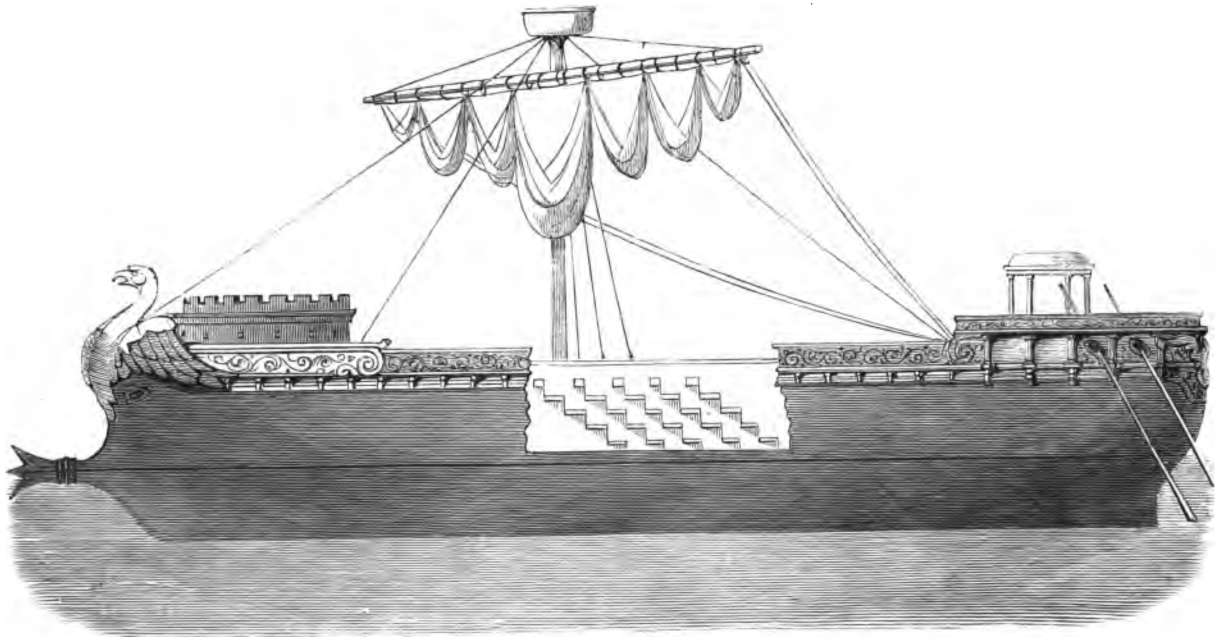


FIG. 4.

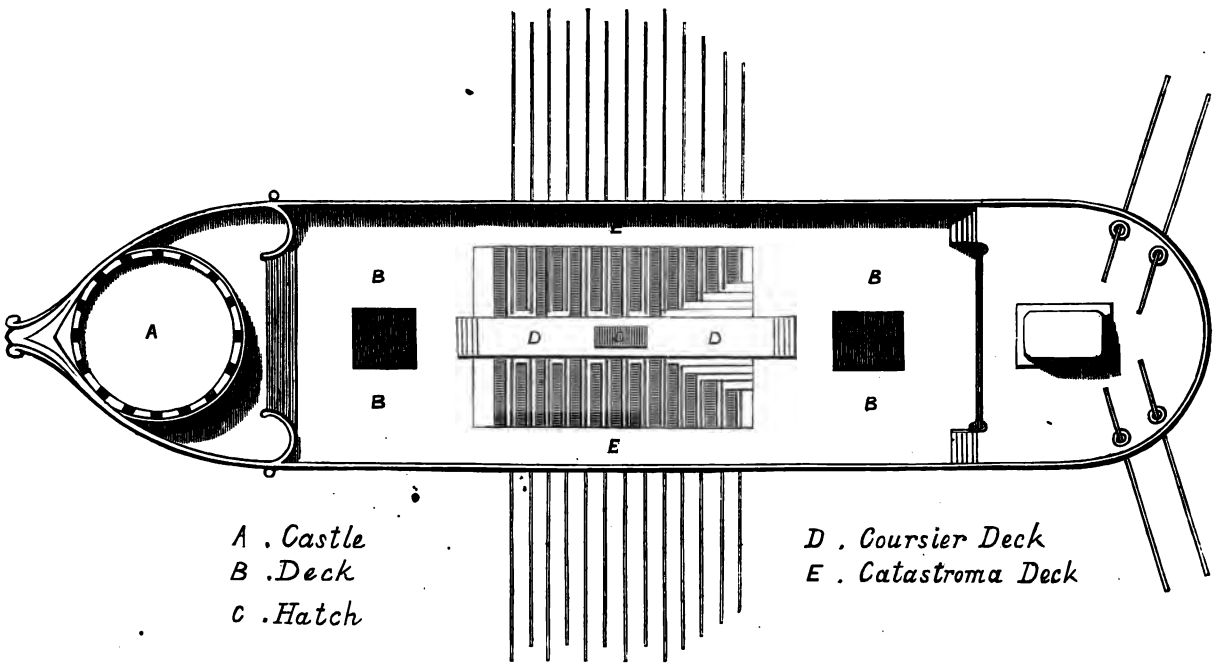

A
B
B
B
B
D
D
C
E
A . Castle
B . Deck
C . Hatch
D . Coursier Deck
E . Catastroma Deck

FIG. 5.

the paddles of the steamer, with the engines, take the position and perform the part of the rowers and their oars. Here modern genius and skill, as it has done in a thousand other instances, substitutes mechanical for manual labour. The modern paddle, in its revolutions, performs exactly the same duty as the oars of the ancients in their simultaneous movements, and the well-trained crews of the Grecian and Roman galleys in their action at the oars, were, so far as is traceable, almost as regular as the beat of the paddle-wheel.

Nor was it necessary to appropriate for the use of the rowers, even when three hundred men were engaged, a larger space in the ship than would now be required for a steam engine of one hundred and fifty horse-power, and her fuel for twenty days. A glance at the illustrations will show that, by the plan suggested, the whole of the fore and after holds with the midship portion of the galley, besides a large space below the platform of the rowers, could be appropriated to cargo and stores, the fore and after maindecks to troops, while the rowers themselves could be berthed in that portion of the vessel where they performed their daily toil, and where there would be space, however uncomfortable, for their beds and scanty apparel. These arrangements will, however, be better understood by a reference to the accompanying deck plan [Fig. 5], and comparing it with the side view and midship section previously given. Here it will be seen that the portion of the galley occupied by the rowers was open, though doubtless covered with an awning in warm, and a tarpaulin in wet weather. To have enclosed this

space with a deck would have been fatal to the men, as human beings, especially during the summer months, almost the only time when the galleys were employed, could not have existed, much less have laboured in a confined hold. Besides being open, there would be thorough ventilation, not merely by means of the air passing through the oar-ports, but by the constant current which, in all weathers, passed through the trellised framework, extending from the upper stringer or gunwale to the side platform or *catastroma*, where the troops were frequently placed, and which formed the connection between the poop and forecastle decks. "The soldiers," remarks Thucydides, "occupied the catastroma on the further side." It will therefore be seen, that this form of an ancient war-galley, while it answers every requirement of such a vessel, corresponds, even in matters of detail, with the scanty and imperfect accounts of ancient writers. "When they began," remarks Thucydides[17] in another place, "to engage with each other, they could not be easily pulled asunder, both on account of the multitude of ships, and also because they chiefly trusted to the soldiers on the catastroma for obtaining the victory."

It may, however, be remarked that in all such matters the statements of the ancient writers are frequently very conflicting, or apparently so. For instance, the same author, describing the galleys of the Bœotians and of Philoctetes, of whom Homer also writes, says, "Nor had they, as yet, *covered* ships;"[18] whereas we find in the 'Iliad' such expres-

[17] Vol. i. cap. xlix. [18] *Ibid.* cap. x.

sions as, "He marched upon the *hatches* with long strides;" and in the 'Odyssey,' where Ulysses is preparing to encounter Scylla, "upon the *hatches* of the prow of the ship he went." Mr. Howell, it is true, in opposition to the views of most translators, says that the hatches should be construed as meaning "the thwarts or seats upon which the rowers sat:"[19] but it is obvious that no other construction can be put upon the word except that it meant the hatches of the hold, which being slightly elevated above the level of the deck, would be a much more likely place for the master or officer of the galley to walk than upon the thwarts where the rowers sat; and this opinion is confirmed by the expression in the latter quotation, where "the hatches *of the prow*" are distinctly mentioned as the covering of the entrance to the fore-compartment or hold of the galley.

These conflicting statements may, however, be easily accounted for by the fact that, though portions of the galleys were open, other portions were decked, while the proportion of the open and closed spaces must have varied according to the class and size of the galleys or the purposes for which they were employed. In all such matters, also, different nations had doubtless different arrangements, if not in the form, at least in the outfit and general equipment of their galleys, and these must have undergone great changes in the course of centuries. Nor does it modify the opinion that "hatches" in their literal sense are meant, for in the time of Homer, though the galleys were all single-banked and "open," they had a deck in midships and at the bow and the stern,

[19] Howell's Pamphlet, p. 7.

as well as the catastroma or platform in the waist, for the use of the soldiers.

Although most of the war galleys of the ancients had high towers at the stern, and more especially at the bow, these were frequently temporary erections, and did not interfere with the general plan of the solid hull of the ship. Nor need they be here noticed, as little or no difference of opinion exists in regard to them. It may, however, be remarked that they appear to have varied in form and size, with the galley, the purposes to which she was applied, or the fancy of her owners; and that the oar-ports could not have been of the form generally drawn. They are more likely to have been ⌷ oblong, fashioned in such a shape as to allow the oar which, in large galleys of many banks, could only be unshipped by being passed outwards, to be brought pretty close alongside of the vessel when the rowers ceased work. In regard to the seats, stools, or benches of the rowers, so frequently mentioned, and which have created a good deal of controversy, the plan here suggested satisfies all these requirements, for to each rower a separate seat or stool attached to the oblique benches or steps is appropriated. The height of each of the oar-ports above the level of the water, in that of the quinquereme, and in all vessels of greater dimensions, would be as follows:—

	ft.	in.
From the first or lowest *port* to water line	2	0
Distance between 1st and 2nd port . . .	1	9
„ „ 2nd „ 3rd „ . . .	1	9
„ „ 3rd „ 4th „ . . .	1	9
„ „ 4th „ 5th „ . . .	1	9
	9	0

So that the height of the sill of the port on the fifth or highest bank would 9 feet above the water line.

The space between the rowers seated on their respective benches or platforms, doubtless varied according to the size of the galley. While from four to six feet between each rower seated on the same level would be ample in the case of either uniremes, biremes, or triremes, galleys of the larger class, in many cases, most likely had an intervening space of from six to even ten feet, so as to afford room for the sweep of the handles of the oars, and enable the rowers to walk one or two steps aft and then throw themselves backwards with greater impetus into their seats as already described.

Summary.

The conclusions at which we have arrived may be condensed as follows:—

1. Ancient galleys were classed or rated according to their number of banks, rows or tiers of oars.

2. All galleys above the unireme had their oar-ports placed obliquely above each other in horizontal rows.

3. No galley had more than five horizontal rows.

4. Every galley, from the unireme to the quinquereme inclusive, derived its name or class from the number of *horizontal* rows.

5. All galleys, above a quinquereme, were likewise classed according to the number of rows. In their case, however, the *oblique* rows were counted; but, in all cases, from the smallest to the largest, including Ptolemy's tesseraconteres, *each row, whether oblique or horizontal, was a distinct bank of oars*, which, like the number of guns wherever they were

placed in wooden men-of-war, *constituted the only basis for their classification.*

6. The portion of the galley appropriated to the rowers and their oars, was as separate from the other portions of the vessel as is the machinery of a paddle-wheel steamer. The rowers, also, like the modern engineers and stokers, were entirely distinct from the seamen and marines; and amongst them were leaders and crack rowers, who were as indispensable to get the galley under weigh and keep the rest of the rowers in time, as are the engineers of our own day, who start and keep the machinery in proper working order.

In a word, the row-galley constituted the steamship of the ancients, as distinguished from their sailing vessels. She had sails to aid her progress when the winds were fair, as a steamer now has, but the one depended on her oars as much as the other now does upon her machinery; and, however vast the improvements, there is really no difference in principle between the galley of the ancients and the steamship of to-day. In practice they are the same, except that steam is substituted for manual labour. An oar is a paddle, and the blades of the oars fastened together, like the spokes round the axle of a wheel, and projecting into the water, constitute the paddle-wheel of modern times.